

# **THE OSWALDO CRUZ INSTITUTE MOLLUSK COLLECTION: IMPROVEMENTS ON DIVERSITY AND INFRASTRUCTURE OVER THE LAST YEARS**

A Coleção de Moluscos do Instituto Oswaldo Cruz: melhorias em diversidade e infraestrutura ao longo dos últimos anos

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## **ABSTRACT**

This study aimed at analyzing the Oswaldo Cruz Institute Mollusk Collection (CMIOC) database in relation to the diversity of families and geographic distribution of the lots, as well as to divulge the improvements on infrastructure over the last years. Currently, CMIOC includes 10,102 lots of freshwater (17 families; including syntypes and topotypes) and terrestrial gastropods (23 families), and bivalves. Planorbidae is the most representative family (6,330 lots), while *Biomphalaria straminea*, the most sampled species (1,084 lots), followed by *B. glabrata* (612 lots), and *B. tenagophila* (581 lots). The second most representative family is Ampullariidae (1,255 lots). Although, terrestrial gastropods include only 181 lots, they represent 23 families, being Subulinidae (59 lots), Bulimulidae (16 lots), and Succineidae (24 lots) the most well represented. A total of 61 countries are represented on CMIOC. It includes mainly specimens from Brazil (8,760 lots), representing all 26 Brazilian States plus the Federal District, especially from the Rio de Janeiro State, with samples from all its 92 municipalities (1,647 lots). Improvements on infrastructure include new rooms, cabinets, equipment, and staff, which have been possible thanks to institutional and external financial support. CMIOC has been notoriously playing an important role for different malacological studies on public health and biodiversity, having a great potential to expand and contribute in many other areas of knowledge.

**Keywords:** Snails, Slugs, Bivalves, Medical Malacology.

## **RESUMO**

Este estudo teve como objetivo analisar a Coleção de Moluscos do Instituto Oswaldo Cruz (CMIOC) em relação à diversidade das famílias e à distribuição geográfica dos lotes, além de divulgar as melhorias na sua infraestrutura ao longo dos últimos anos. Atualmente possui 10.102 lotes de gastrópodes de água doce (17 famílias; incluindo sintipos e topótipos) e terrestres, além de bivalves. Planorbidae é a família mais representada (6.330 lotes), sendo *Biomphalaria straminea* a espécie com maior número de lotes (1.084 lotes), seguida de *B. glabrata* (612 lotes) e *B. tenagophila* (581 lotes). A segunda família mais representada é Ampullariidae (1.255 lotes). Embora a CMIOC possua apenas 181 lotes de gastrópodes terrestres, há exemplares de 23 famílias, sendo Subulinidae (59 lotes), Bulimulidae (16 lotes) e Succineidae (24 lotes) as mais bem representadas. A CMIOC possui exemplares de um total de 61 países, principalmente do Brasil (8.760 lotes), provenientes de todos os 26 Estados brasileiros, além do Distrito Federal. Dentre os estados, o mais bem representado é o Rio de Janeiro, com amostras de todos os 92 municípios (1647 lotes). Melhorias na infraestrutura incluem novas salas, armários, equipamentos e pessoal, obtidos através do comprometimento institucional e de aporte de recursos financeiros, tanto institucional quanto externo. A CMIOC tem notoriamente desempenhado um papel importante na Malacologia, principalmente para a saúde pública e a biodiversidade, tendo um grande potencial para expandir e contribuir para outras diversas áreas do conhecimento.

**Palavras-chave:** caracóis, lesmas, bivalves, Malacologia Médica.

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## INTRODUCTION

Biological collections have great importance in the international context, especially after the Convention on Biological Diversity, which determined that countries should establish and maintain facilities for *ex situ* conservation of scientific material. They are an essential database for numerous studies, including knowledge on biodiversity and taxonomy, and the reconstruction of patterns and process of evolution and diversity changes over time and space (Wandeler *et al.*, 2007; Bi *et al.*, 2013). They also allow the evaluation of environmental impacts, conservation policies, agriculture, public health, safety, and national security, as well as the management of new biotechnological products, and others (Cowie, 2005; Marburger & Bolten, 2009; Bi *et al.*, 2013).

The Oswaldo Cruz Institute Mollusk Collection (CMIOC) is a significant source of information, mainly on freshwater species, and contains important species to Brazilian society regarding parasitic diseases, economic losses on agriculture and native species. It was created by Wladimir Lobato Paraense and Newton Deslandes in 1948 to support studies on medical malacology, at the Public Health Special Service (SESP) located at that time in Belo Horizonte, Minas Gerais State. The service was in charge of providing control of several parasitic diseases in the Rio Doce Valley, including schistosomiasis (Varga, 2007). In 1957, W. L. Paraense and the Mollusk Collection moved to the National Institute for Countryside Endemias - INERU (currently René Rachou Institute/Fiocruz), at Belo Horizonte, where both stayed until 1968. Invited to teach at the University of Brasilia - UNB, at the Federal District, W. L. Paraense took with him the Collection and both stayed there until 1977, when he came to the Oswaldo Cruz Institute (IOC), Rio de Janeiro (Paraense *et al.*, 2005). Since then, the collection is housed and under the care of the staff of the Laboratory of Malacology (LABMAL), at the Oswaldo Cruz Institute/Fiocruz, where it has grown in value, having acquired substantial improvements on its diversity, structure, and staff, mainly in the last few years.

In this study we aimed at examining the CMIOC database in relation to the diversity of families and geographic distribution of the lots, as well as to divulge the improvements in infrastructure over the last years.

## MATERIAL AND METHODS

The data related to diversity of taxa are based on an Excel database obtained in June 15<sup>th</sup>, 2016

containing 10,102 lots, based on which some percentages are presented. The database is based on a collection formed by dry preserved shells and fluid preserved bodies, in Railliet-Henry fixative and/or ethanol 75% for anatomical studies, and in ethanol 80-95% or absolute for DNA analysis.

Dry shells are packed in glass vials or plastic bags. Complete specimens are preferentially maintained separated, with their bodies extracted from their shells in the most cases. The lots receive the acronym "CMIOC" and a sequential number from the catalogue. The information about each lot is cataloged in a handwritten book and in an Excel file. It includes data about its classification and taxonomic identification, collecting data (e.g. date, country, State/Department/Province, locality, collecting site, collectors, and geographic coordinates), number of specimens, and other available data.

After cataloging, the lots receive two labels, one attached to the outside of the glass or plastic bag and another small label indicating the CMIOC catalogue number placed inside the containers.

Continuous preservation of the lots is performed, which involves checking and replacement of vials, labels, and review of the material in relation to its taxonomy and/or reclassification when necessary.

Photos of the shells of freshwater species were obtained using Leica M205C with image capture system DMC2900 and a software that allows capturing a series of images focused at different depths through the samples. Living specimens were photographed using a Canon PowerShot G11 Digital Camera.

Mentioned improvements on infrastructure are those occurred mainly from 2013 onwards.

## RESULTS AND DISCUSSION

As of June 2016, the collection contained 10,102 catalogued lots of dry and wet specimens of gastropods and bivalves, comprising approximately 200,000 specimens. The collection includes mainly materials from Brazil (8,760 lots), representing all 26 Brazilian States plus the Federal District (Figure 1). The Rio de Janeiro State is the most representative State, with samples from all its 92 municipalities (1,647 lots). Other representative countries are Argentina (325 lots) and Uruguay (141 lots), although it includes samples from all American Continent, Europe, Asia, and Oceania, covering 61 countries.

The majority of the specimens is represented by freshwater gastropods (Figure 2), which amount a total of 9,777 lots and 17 different families (Figure 3A). More than half these lots is represented by

Planorbidae (6,330 lots), including Ancylini species (540 lots) that was classified in Ancyliidae family, being just recently reclassified as a subfamily of Planorbidae (Albrecht *et al.*, 2007). The three *Biomphalaria* species carriers of schistosomiasis in Brazil (Thiengo & Fernandez, 2008) together represent 53% (3,367 lots) of the Planorbidae lots,

being *Biomphalaria straminea* the most represented, including 1,084 lots, whereas *B. glabrata* and *B. tenagophila* includes 612 and 581 lots, respectively. The second most represented family (Ampullariidae, 1,255 lots) is a specialty of the last author, who was the assistant curator of CMIOC from 1984 to 2008, when she became the senior curator.

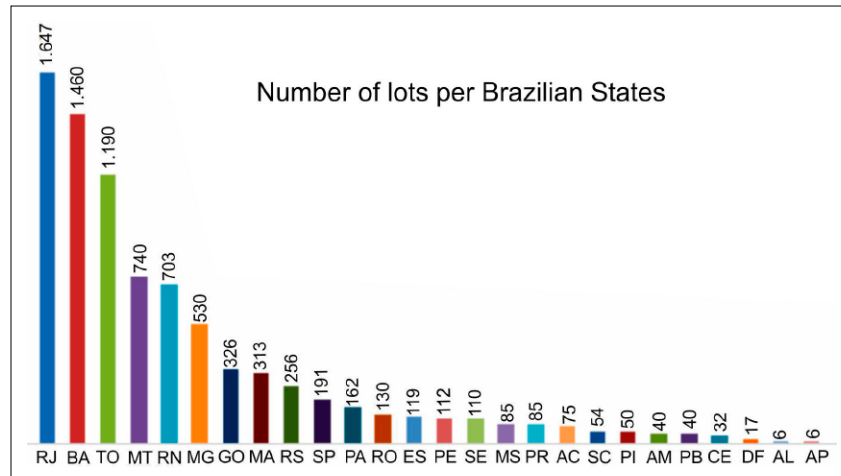


Figure 1: Number of lots per Brazilian States at CMIOC.

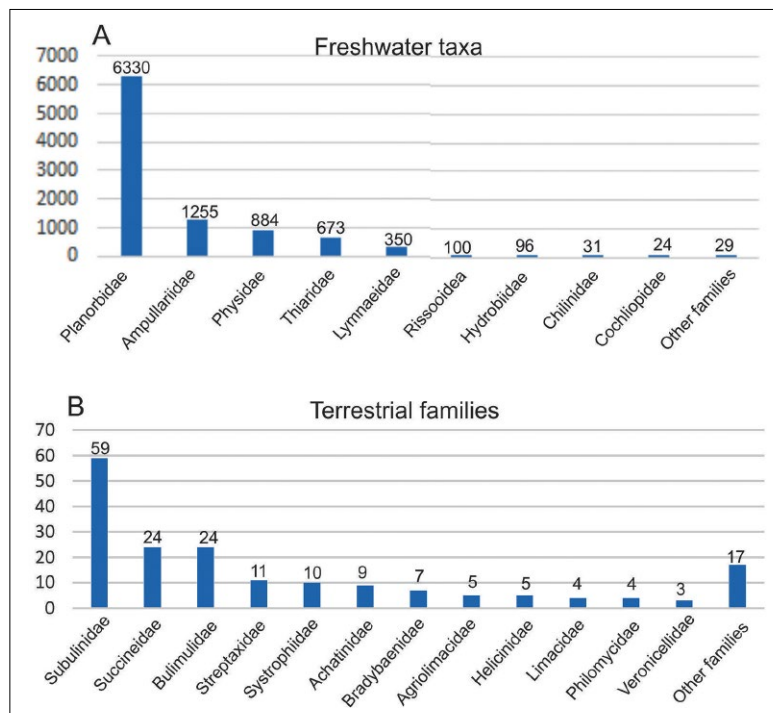


Figure 2 - Shells of freshwater gastropods represented at CMIOC (dorsal, frontal, and ventral position, respectively). A. *Biomphalaria glabrata* (Say, 1818) (CMIOC 1); B. *Biomphalaria straminea* (Dunker, 1848) (CMIOC 5); C. *Biomphalaria subprona* (Martens, 1899) (CMIOC 2.305); D. *Biomphalaria obstructa* (Morelet, 1849) (CMIOC 2.319); E. *Helisoma anceps* (Menke, 1830) (CMIOC 4); F. *Drepanotrema lucidum* (Pfeiffer, 1839) (CMIOC 10); G. *Plesiophysa ornata* (Haas, 1938) (CMIOC 2) (Planorbidae); H. *Physa marmorata* Guilding, 1828 (CMIOC 10.186) (Physidae); I. *Pomacea maculata* Perry, 1810 (CMIOC 7.122) (Ampullariidae).

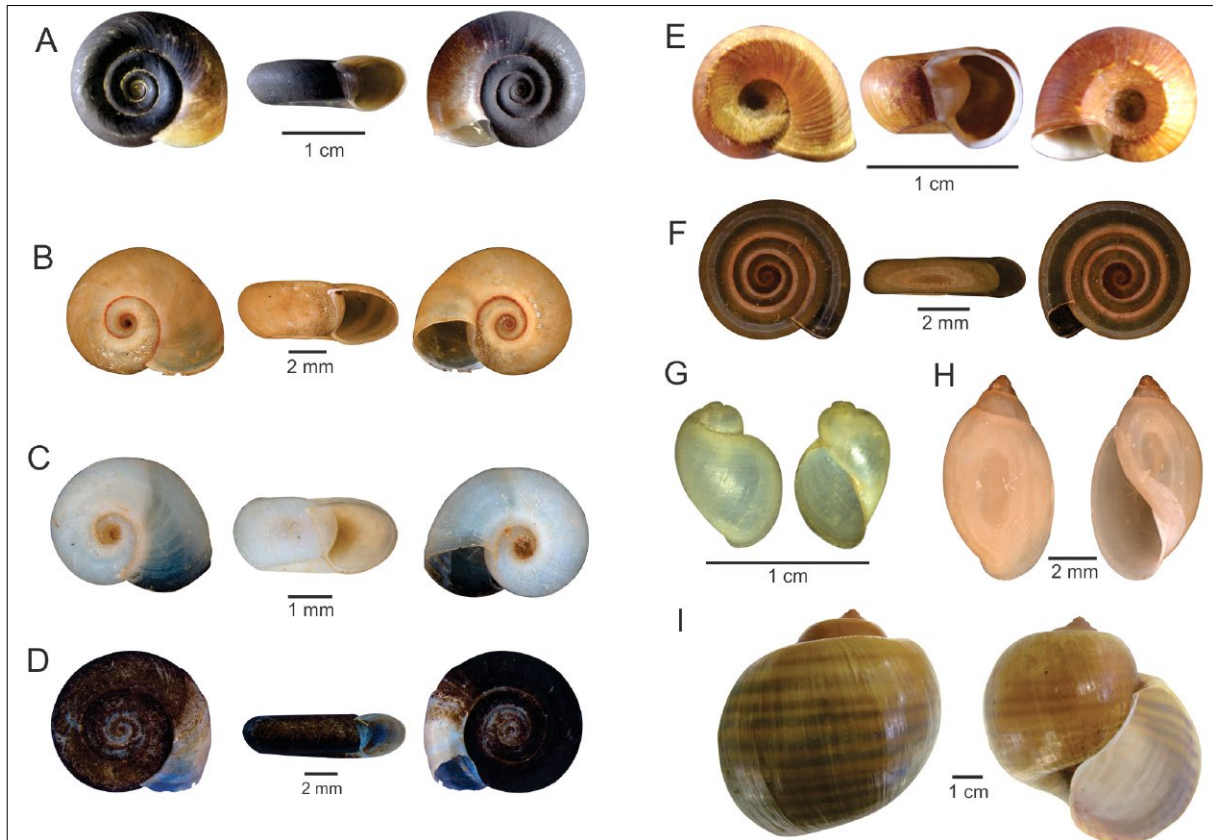


Figure 3: Diversity of gastropod families in relation to the total number of lots. A. Freshwater taxa. Other families are the following: Litoglyphidae, Neritidae, Pomatiopsidae, Bithyniidae, Bithyniidae, Viviparidae, Acroloxidae, Pachychilidae, and Valvatidae, with one to nine lots. B. Terrestrial families. Other families, with one or two lots, are the following: Arionidae, Eucolunidae, Helicarionidae, Megalobulimidae, Odontostomidae, Potieriidae, Ariophantidae, Milacidae, Simpulopsidae, Solaropsidae, Pleurodontidae. The numbers above the bars correspond to the number of lots.

In addition to Planorbidae and Ampullariidae, other freshwater families and superfamilies found in the CMIOC are: Chiliniidae, Cochliopidae, Hydrobiidae, Lymnaeidae, Physidae, Rissosoidea, and Thiaridae, besides Litoglyphidae, Neritidae, Pomatiopsidae, Bithyniidae, Viviparidae, Acroloxidae, Pachychilidae, and Valvatidae which are represented by few lots (one to nine lots).

The CMIOC includes syntypes of *Biomphalaria cousini* Paraense, 1966, *Biomphalaria occidentalis* Paraense, 1981, *Biomphalaria oligoza* Paraense, 1974, *Biomphalaria orbignyi* Paraense, 1975, *Biomphalaria tenagophila guaibensis* Paraense, 1984, *Drepanotrema pileatum* Paraense, 1971, *Australorbis intermedius* Paraense, 1962 (= *Biomphalaria intermedia* (Paraense, 1962), *Lymnaea rupestris* Paraense, 1982 and *Plesiophysa dolichomastix* Paraense, 2002. It also includes topotypes of species that were redescribed by W.L. Paraense: *Biomphalaria kuhniana* (Clessin, 1883), *Biomphalaria subprona* (Martens, 1899), *Biomphalaria obstructa* (Morelet, 1849), *Lymnaea diaphana* King, 1830, *Lymnaea viatrix* d'Orbigny, 1835

and *Physa acuta* Draparnaud 1805 (Paraense, 1976, 1984, 1988, 1990, 1996, 2003).

Terrestrial gastropods started to be included at CMIOC in 2015. Although the collection still contains only 181 lots of terrestrial mollusks, they comprise 23 terrestrial families (Figure 3B): Achatinidae, Agriolimacidae, Bradybaenidae, Bulimulidae, Helicinidae, Limacidae, Philomycidae, Streptaxidae, Subulinidae, Succineidae, Systrophiiidae and Veronicellidae. Arionidae, Eucolunidae, Helicarionidae, Megalobulimidae, Odontostomidae, Potieriidae, Ariophantidae, Milacidae, Simpulopsidae, Solaropsidae and Pleurodontidae are represented by one or two lots. Whenever living specimens are received to be deposited at CMIOC, they have been photographed before being preserved and stored (Figure 4). The most represented families are Subulinidae (59 lots), Bulimulidae (16 lots), and Succineidae (24 lots). We emphasize that forms of land slugs and semi-slugs, which are also often unsatisfactorily represented in Brazilian scientific collections and unsatisfactorily



studied, have representatives of nine families in CMIOC, containing lots of species from Brazil and other countries: Arionidae, Agriolimacidae, Ariophantidae, Helicarionidae, Limacidae, Milacidae, Succineidae, Philomycidae, and Veronicellidae. The terrestrial mollusks are represented by endemic species from Brazilian biomes, such as the Atlantic Forest, mainly from the Rio de Janeiro State, and by exotic and invasive species common in urban and agricultural areas of Brazil and other countries.

Several species of terrestrial gastropods act as intermediate hosts of nematodes and trematodes that cause parasitic diseases and have been extensively mentioned as important pest species of various kinds of crops (Thiengo, 2007; Ohlweiler *et al.*, 2010). According to Santos *et al.* (2009) and Simone (2006), 700 species of land gastropods are listed for Brazil, which represent less than 5% of the estimated terrestrial gastropods in the world, despite the

flaunted Brazilian fauna. Currently in Brazil, there are few official malacological collections interested on terrestrial species and containing specialized curators, and the majority of these collections are located in Southern and Southeastern Brazil.

Bivalvia is currently represented by only 130 lots from four different families of freshwater species (Corbiculidae, Hyriidae, Mycetopodidae, and Sphaeriidae), since it was not the main goal of the collection.

The CMIOC has grown significantly in number and diversity of samples thanks to various research projects developed by the staff of the LABMAL, in addition to those of collaborative researchers. A good example of a collaborative project was that performed with the Superintendency for Public Health Campaigns (SUCAM) in the 1980s, which generated material from several Brazilian states, providing 1,044 lots to CMIOC. Similarly, the "Planorbids Survey Project" developed in recent



Figure 4 - Specimens of native and exotic terrestrial gastropods species of CMIOC. Photos of living specimens before fixed and stored at CMIOC. A. *Cochlorina aurisleporis* (Brugüiere, 1792) (CMIOC 10.062); B. *Drymaeus papyraceus* (Mawe, 1823) (CMIOC 10.099) (Bulimulidae); C. *Megalobulimus paranaguensis* (Pilsbry & Ihering, 1900) (CMIOC 10.100) (Megalobulimidae); D. *Streptaxis contusus* (Férussac, 1821) (CMIOC 10.070) (Streptaxidae); E. *Helicina inaequistriata* (Pilsbry, 1900) (CMIOC 10.024) (Helicinidae); F. *Leiostracus perlucidus* (Spix, 1827) (CMIOC 9.994) (Bulimulidae); G. *Meghimatium pictum* (Stoliczka, 1873) (CMIOC 9.984) (Philomycidae); H. *Limacus flavus* (Linnaeus, 1758) (CMIOC 9.980); *Leptinaria unilamellata* (Brugüiere, 1789) (CMIOC 10.086) (Subulinidae). Scale: 5 mm.

years generated samples from several Brazilian states: Rio de Janeiro (Thiengo *et al.*, 2001; Thiengo *et al.*, 2002ab; Thiengo *et al.*, 2004ab; Thiengo *et al.*, 2006), Maranhão (Cantanhede *et al.*, 2014), Pernambuco and Rio Grande do Norte (Favre *et al.*, 2016), besides Minas Gerais, Bahia and Paraná. Other projects made it possible to obtain samples from biotypes that do not exist anymore, as a result of important environmental changes that happened at those sites, as for example in the Tocantins, Goiás, and Minas Gerais States (Thiengo *et al.*, 2005; Fernandez *et al.*, 2014), where hydropower plants were built, submerging innumerable streams and natural lakes.

The expansion of collections is necessary not only for the continuous knowledge on the diversity, which is far from being completely known, and for the species conservation, but also considering the vital role of them for society. Collections play an important role to public health and safety, to improve national security, to monitor environmental changes, in addition to support researches in several fields. Brazilian biological collections are deemed sufficient for the study of only about 25% of the taxa, and are considered considerably inadequate for 27% of them. Moreover, there is a critical deficiency of curators (Lewinsohn & Prado, 2003).

Increasingly all collection of Fiocruz are acknowledged as of great value, being the Oswaldo Cruz Institute undoubtedly the main protagonist of actions aimed at improving the infrastructure of the collections it houses. CMIOC recent improvements in sample storage and preservation include the separation of the wet from the dry collection into two separate rooms, and their subsequent transfer to two new sliding compacting metal cabinets (Figure 5) in 2013 and 2016, respectively. Moreover, cotton and paper labels included inside all vials containing shells were removed in order to avoid the acids produced by these materials. The dry collection is still being organized in the new room, where temperature and humidity is going to be monitored, as it is already being done at the wet collection room. Temperature and humidity at the wet collection room

are kept around 18 °C and 50%, respectively. Both, temperature and humidity, are a concern in storing a collection, since at higher temperatures, chemical reactions in an atmosphere containing acids (as from paper labels, wood, and Railliet-Henry solution) can affect the shells (Bynesian decay or Byne's disease). In general, for mollusks, a temperature in the range of 16-21°C and relative humidity within the range of 50-55%, is considered good (Sturm, 2006). Kovacic (2009) underlines that keeping specimens in good conditions is a greater necessity for any collection than any quantification.

Since 2012, the CMIOC database can also be accessed through the "SpeciesLink network", with free access to the general public. The network is fed with data from an internal Excel file, which is continuously updated by CMIOC staff. In addition, since 2014, curators and the staff of the Oswaldo Cruz Institute zoological collections and an informatics team are creating a new software, which will serve to record material deposit, data, and services for these collections, as well as reports and even labels. In the last years, all records of activities and services were kept in standard forms created by an Institute Oswaldo Cruz's collections committee. Furthermore, curators and quality manager have been working on the elaboration of standard operating procedure informing step-by-step the main procedures developed at the collection.

In 2016, CMIOC received a new Leica M205C with an image capture system DMC2900. The system is also available to support other of Oswaldo Cruz Institute zoological collections. Its main goal is to make collections data widely available via the

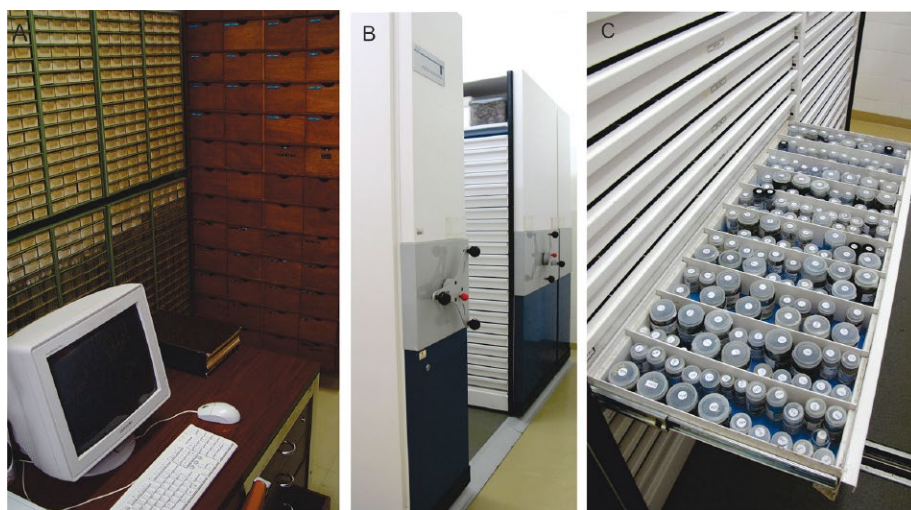


Figure 5 - Cabinets where the CMIOC has been stored. A. Inside small drawers in 1980's; B. Current inside metal sliding compacting cabinets.



Internet, by improving access to the scattered biodiversity information base, also helping to preserve them. Speers (2005) highlights that recent advances in digital imaging technology, broadband Internet connectivity, computer software for manipulating digital images, and image-compatible database software now help natural history collections be more practical and efficient, making digital images globally accessible. Baeman & Cellinese (2012) mention that digitization, beyond making collections more accessible to researchers, provides access to downstream users, such as the general public, government and non-government agencies, as well as private enterprises. In many cases, however, digital images of the shells will not be a substitute for researcher physically examining specimens, as those where anatomy needs to be analyzed, but the access to these images will significantly reduce the need for travel, loan, and specimens handling.

The CMIOC has changed its staff from time to time, depending on the availability of funds. Currently, it consists of two permanent federal employees, represented by the senior and the assistant curators, besides three students supported by scholarships (two graduate and one undergraduate), and a quality manager. Two of these scholarships are supported by institutional funds (IOC), while the other, by federal funds (the Brazilian Development Bank - BNDES, and the National Council for Scientific and Technological Development - CNPq).

The CMIOC has also been offering services as identification, consulting, and loaning of specimens, and providing didactic material on trainings, universities; and Municipal, State, and Federal institutions. It also provides space, facilities, and when available, financial support for malacologists who come to work and update taxonomic data in the collection.

## CONCLUSIONS

Currently, CMIOC presents its best condition since its inception, in terms of diversity, infrastructure, and staff. In addition, it has a potential to expand, considering the last improvements in these three fields, mainly regarding terrestrial mollusks that just started to be included in the collection. These improvements have been possible thanks to institutional efforts, which was the foundation and important driver for the improvements achieved in CMIOC, in addition to external financial support. Both have been supporting collecting, new cabinets,

rooms, and human resources, as well as the continuous optimization in the quality management, which have been highly relevant for the conservation and development of the collection. Lastly, CMIOC is indeed an important Brazilian biological resource heritage and keeps providing subsidies for further researches and projects for all those interested on mollusks in the most different areas of knowledge.

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